REMARKS

It is believed that the following remarks attend to all rejections and objections presented in the pending May 21, 2003 office action; these remarks are numbered with corresponding paragraphs to this office action.

RESTRICTION

1-5. Claims 1-18 are subject to restriction. We hereby affirm election of claims 1-13. Claims 14-18 may be filed in a divisional application.

OBJECTIONS TO THE SPECIFICATION

6. The specification is objected to by referring to numerals 16, 20 and 35, while showing only numerals 16A/16B, 20A/20B and 35A/35B, respectively. The specification is amended, above, to clarify this numbering. Reconsideration is requested.

7. The specification is further objected to as having double numbering of "32". This too is corrected by amendment, above, to the specification and FIG. 3.

8. CLAIM REJECTIONS UNDER 35 USC § 112

9. Claims 8-9 stand rejected due to antecedance of "second" heater/conduit. Claim 8 is corrected to depend from claim 7, thereby obviating the objection. Reconsideration is requested.

10. CLAIM REJECTIONS UNDER 35 USC § 103

Claims 1-13 stand rejected as being unpatentable over any one of U.S. Patent No. 6,215,166 ("McDunn"), U.S. Patent No. 6,242,778 ("Marmillon"), U.S. Patent Publication No. 2002/0023841 ("Ahn") in view of U.S. Patent No. 4,912,600 ("Jaeger"). Respectfully we disagree, since the cited art does not render claims 1-13 *prima facie* obvious. The following is a quotation of from the MPEP setting forth the three basic criteria that must be met to establish a *prima facie* case of obviousness:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the references or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. MPEP, §2142, citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Among other reasons, McDunn, Ahn, Marmillon and Jaeger do not teach each and every feature of claims 1-13, and cannot therefore anticipate or render these claims obvious. Applicants' claim 1 requires the following elements:

(A) a die having plurality of micro-channels; and

(B) a condenser in fluid communication with the micro-channels, wherein die heating vaporizes fluid at the die to force fluid towards the condenser. As argued below, the cited art (alone or in combination) fails to teach or suggest features of Applicants' claim 1 or Applicants' claims 2-13 combined with claim 1.

First, and generally, McDunn teaches a semiconductor die receiving atomized fluid using "conventional" means for providing fluid flow. McDunn, col. 3, lines 26-31. A closed-loop fluid flow is mentioned but not shown; however the embodiment envisioned by McDunn is apparent in col. 3, lines 56-65, which describes how a pump and a condenser may be used to supply cooled fluid to nozzles (see col. 3, lines 34-41) and then to an exposed surface 23. Once exposed, a thin film liquid forms on surface 23 and heat is removed by evaporation; excess fluid is removed by "well known methods" (see col. 3, lines 42-50). There is, therefore, no teaching or suggestion of a condenser in fluid communication with micro-channels in the die such that die heating forces vaporized liquid towards the condenser, as required by Applicants' claim 1.

In respect to McDunn, the Examiner states that McDunn also teaches a "sealed member closing the channels except a inlet and outlet. Respectfully, we disagree; there is no such teaching. McDunn merely shows an exposed die 12, with wire bonds

24 and electrical leads 25 connected thereto. Nothing in McDunn suggests sealing microchannels (moreover, it is not even clear that McDunn teaches microchannels).

The Examiner then argues that Jaeger fills the void of McDunn by providing a "notoriously known" liquid cooling system with condenser and gravity flow. We cannot disagree more; and we stress that the combination of Applicants' claim 1 is not obvious except through hindsight. Specifically, in reviewing Jaeger, it is apparent that Jaeger merely teaches a cooling system including a condenser 6 and compressor 1 (a pump) which pumps a refriderant to a computer module 7 (to be cooled) and to an evaporator 8. Jaeger, col. 2, lines 7-15. Jaeger specifcially teaches spraying coolant onto wafer chips 11-13 (through coolant inlets 26, 27) within the computer module 7 to provide high velocity convective cooling and heat transfer (see Jaeger, abstract). Spent coolant exits a chamber 20 to be vaporized by the evaporator 8, whereinafter the compressor 1 repumps the refridgerant to the computer module 7. There is no teaching of a condenser in fluid communication with microchannels, nor of die heating acting as an evaporator to vaporize fluid and force fluid flow back to the condenser. Jaeger thus teaches away from Applicants' claim 1 since, among other reasons, an evaporator 8 is separate and apart from computer module 7 (and specifically distinct from any wafers 10-13 within module 7).

Note in Applicants' claim 1 that die heating vaporizes fluid to force the fluid back to a condenser; there is also, therefore, no "pump" as taught by both McDunn and Jaeger. Jaeger and McDunn are insufficient to render claim 1 obvious since they do not teach the elements of claim 1, namely a die with microchannels in fluid communication with a condenser where die heating vaporizes and forces fluid flow to the condenser. Accordingly, McDunn and Jaeger fail a crucial requirement of 35 U.S.C. §103: that the combination teach or suggest all claim elements. Of course Jaeger and McDunn also fail in other U.S.C. §103 requirements, since there is absolutely no motivation or suggestion to combine McDunn with Jaeger, and since a combination of McDunn with Jaeger would not reasonably succeed to render Applicants' claim 1. Note that McDunn and Jaeger are also non-analogous art: Jaeger

teaches a cooling system while McDunn teaches a radio frequency electronic device. The combination of the two is not reasonable under U.S.C. §103. Reconsideration is requested for Applicants' claim 1, as to McDunn and Jaeger.

Claims 2-13 benefit from like arguments since they depend from claim 1. Moreover, McDunn and Jaeger also fail to teach certain additional features of these claims, as required by U.S.C. §103, including:

- McDunn and Jaeger fail to teach, alone or in combination, a plate coupled with the die for sealing the micro-channels such that the micro-channels form a plurality of fluid conduits for the fluid (claim 2). As noted above, McDunn also does not teach sealing any microchannels, though the Examiner contends otherwise.

- Similarly, McDunn and Jaeger also fail to teach or suggest a plate being formed of semiconductor material (claim 3), glass or silicon (claim 4).

- McDunn and Jaeger further fail to teach a first fluid conduit for coupling cooler fluid from the condenser to the micro-channels (claim 6). Specifically, Jaeger "sprays" fluid onto Ics (see Jaeger, col. 3, lines 10-15). McDunn also sprays coolant onto a die 12 (see McDunn, Fig. 1). In both McDunn and Jaeger, there is no "return" flow of heated fluid, due to die heating (as in Applicants' claim 1). In a similar manner, McDunn and Jaeger also fail to teach a first header for coupling the first fluid conduit to the micro-channels (claim 7), a second fluid conduit for coupling warmer fluid from the micro-channels to the condenser (claim 8), and a second header for coupling the second fluid conduit to the micro-channels (claim 9).

- McDunn and Jaeger further fail to teach of suggest micro-channels that are shaped for preferential fluid flow along one direction in the micro-channels (claim 10). It is impossible to render claim 10 obvious unless there is a

teaching or suggestion for its claim limitation. McDunn and Jaeger simply fail on this account, for this claim and the other claims mentioned.

- Given the above arguments, it is also unreasonable that McDunn and Jaeger teach or suggest a condenser that is above the die such that gravity pressurizes cooler condenser fluid towards the die (claim 11).

- McDunn and Jaeger also do not teach or suggest at least one orifice for restricting fluid flow through at least one of the micro-channels, for preferential fluid flow along one direction in the micro-channels (claim 12).

Applicants request reconsideration of claims 1-13 as to the rejection of McDunn and Jaeger, which are insufficient to render any of these claims obvious according to 35 U.S.C. §103.

The arguments against Ahn and Marmillo, with Jaeger, are quite similar. Apparently, from reviewing the office action, Ahn, Marmillo and McDunn are cited because they utilize "microchannels." It is useful to note that in the background of the present application, Applicants admit prior use of "microchannels" – accordingly, prior art devices incorporating microchannels is known. What is not known is the structure claimed by Applicants in claim 1-13. The citations of Ahn, Marmillo, McDunn and Jaeger simply fail to teach or suggest such a combination (which includes the use of microchannels).

With respect to Ahn, Ahn teaches an electrohydrodynamic convection microfluidic mixer incorporating a silicon wafer 36 with a microchannel 46 for guiding two fluids simultaneously. Ahn, paragraph 9, lines 1-10; FIG. 2; paragraph 50, lines 1-18. It is worth noting that Ahn essentially teaches micro-mixing of the two fluids by application of an electric field to encourage shear forces and mixing at applied electrodes to the silicon wafer. Accordingly, Ahn does not teach any method of cooling.

As in McDunn, therefore, there is once again no teaching or suggestion by Ahn of a condenser in fluid communication with micro-channels in a die such that die heating forces vaporized liquid towards the condenser, as required by Applicants' claim 1. The Examiner thus argues that Jaeger teaches or suggests the missing elements of Ahn (with respect to claim 1), so as to provide a liquid cooling system with condenser and gravity flow. Again, we cannot disagree more; and we stress that the combination of Applicants' claim 1 is not obvious except through hindsight. Again, it is apparent that Jaeger merely teaches a cooling system including a condenser 6 and compressor 1 (a pump) which pumps a refriderant to a computer module 7 (to be cooled) and to an evaporator 8. Jaeger, col. 2, lines 7-15. Jaeger specifcially teaches spraying coolant onto wafer chips (through coolant inlets 26, 27) within the computer system to provide high velocity convective cooling and heat transfer (see Jaeger, abstract). Spent coolant exits a chamber 20 to be vaporized by the evaporator 8, whereinafter the compressor 1 repumps the refridgerant to the computer module 7. There is no teaching of a condenser in fluid communication with microchannels, nor of die heating acting as an evaporator to vaporize fluid and force fluid flow back to the condenser. As noted above, Jaeger in fact teaches away from Applicants' claim 1 since, among other reasons, an evaporator 8 is separate and apart from computer module 7 (and specifically distinct from any wafers 10-13 within module 7).

Note in Applicants' claim 1 that die heating vaporizes fluid to force the fluid back to a condenser; there is, therefore, no pump as taught by Jaeger. Jaeger and Ahn are insufficient to render claim 1 obvious since they do not teach the elements of claim 1, namely a die with microchannels in fluid communication with a condenser where die heating vaporizes and forces fluid flow to the condenser. Accordingly, Ahn and Jaeger fail a crucial requirement of 35 U.S.C. §103: that the combination teach or suggest all claim elements. Jaeger and Ahn also fail in other U.S.C. §103 requirements, since there is absolutely no motivation or suggestion to combine Ahn with Jaeger, and since a combination of Ahn with Jaeger would not reasonably succeed to render Applicants' claim 1. Note that Ahn and Jaeger are also non-

analogous art: Jaeger teaches a cooling system while Ahn teaches fluidic mixing. The combination of the two is not reasonable under U.S.C. §103. Reconsideration is requested for Applicants' claim 1, as to Ahn and Jaeger.

Claims 2-13 benefit from like arguments since they depend from claim 1. Moreover, Ahn and Jaeger also fail to teach certain features of these claims, as required by U.S.C. §103, including:

- Ahn and Jaeger fail to teach a first fluid conduit for coupling cooler fluid from the condenser to the micro-channels (claim 6). Specifically, Jaeger "sprays" fluid onto Ics (see Jaeger, col. 3, lines 10-15). Ahn injects fluid into the micromixer with a syringe 11 (Ahn, FIG. 1). In both Ahn and Jaeger, there is no "return" flow of heated fluid from die heating as an evaporator. In a similar manner, Ahn and Jaeger also fail to teach a first header for coupling the first fluid conduit to the micro-channels (claim 7), a second fluid conduit for coupling warmer fluid from the micro-channels to the condenser (claim 8), and a second header for coupling the second fluid conduit to the micro-channels (claim 9).

- Ahn and Jaeger further fail to teach of suggest micro-channels that are shaped for preferential fluid flow along one direction in the micro-channels (claim 10). It is impossible to render claims like this obvious unless there is a teaching or suggestion for each claim limitation. Ahn and Jaeger simply fail on this account, for this claim and the other claims mentioned.

- Given the arguments before, it is also unreasonable that Ahn and Jaeger teach or suggest a condenser that is above the die such that gravity pressurizes cooler condenser fluid towards the die (claim 11).

- Ahn and Jaeger also do not teach or suggest at least one orifice for restricting fluid flow through at least one of the micro-channels, for preferential fluid flow along one direction in the micro-channels (claim 12).

Applicants request reconsideration of claims 1-13 as to the rejection of Ahn and Jaeger, which are insufficient to render any of these claims obvious according to 35 U.S.C. §103.

With respect to Marmillo, Marmillo teaches a cooling method for silicon on insulator devices. A semiconductor chip 10, formed of substrates 20, 30, incorporates cooling channels 22 for circulating cooling fluid. Marmillo, FIG. 1 and col. 3, lines 58-67. The Examiner states that "Figures 4 and 5 of Marmillo show the fluid flow and shape channels as claimed." However, these figures only show microchannels – *without* shape or orifice (as required in Applicants' claims 10, 12). Accordingly, Marmillo is apparently cited because it uses microchannels; however, like McDunn and Ahn, Marmillo is silent as to the features of claim 1.

Specifically, there is once again no teaching or suggestion within Marmillo of a condenser in fluid communication with micro-channels in the die such that die heating forces vaporized liquid towards the condenser, as required by Applicants' claim 1. The Examiner thus argues that Jaeger teaches or suggests the missing elements of Marmillo (with respect to claim 1) by providing a liquid cooling system with condenser and gravity flow. Again, we cannot disagree more; and we stress that the combination of Applicants' claim 1 is not obvious except through hindsight. Again, it is apparent that Jaeger merely teaches a cooling system including a condenser 6 and compressor 1 (a pump) which pumps a refriderant to a computer module 7 (to be cooled) and to an evaporator 8. Jaeger, col. 2, lines 7-15. Jaeger specifcially teaches spraying coolant onto wafer chips (through coolant inlets 26, 27) within the computer system to provide high velocity convective cooling and heat transfer (see Jaeger, abstract). Spent coolant exits a chamber 20 to be vaporized by the evaporator 8, whereinafter the compressor 1 repumps the refridgerant to the computer module 7. There is no teaching of a condenser in fluid communication with microchannels, nor of die heating acting as an evaporator to vaporize fluid and force fluid flow back to the condenser. As noted above, Jaeger in fact teaches away from Applicants' claim 1 since, among other reasons, an evaporator 8 is separate and apart

from computer module 7 (and specifically distinct from any wafers 10-13 within module 7).

Jaeger and Marmillo are insufficient to render claim 1 obvious since they do not teach the elements of claim 1, namely a die with microchannels in fluid communication with a condenser where die heating vaporizes and forces fluid flow to the condenser. Accordingly, Marmillo and Jaeger fail a crucial requirement of 35 U.S.C. §103: that the combination teach or suggest all claim elements. Of course Jaeger and Marmillo also fail in other U.S.C. §103 requirements, since there is absolutely no motivation or suggestion to combine Marmillo with Jaeger, and since a combination of Marmillo with Jaeger would not reasonably succeed to render Applicants' claim 1. Reconsideration is requested for Applicants' claim 1, as to Marmillo and Jaeger.

Claims 2-13 benefit from like arguments since they depend from claim 1. Moreover, Marmillo and Jaeger also fail to teach certain features of these claims, as required by U.S.C. §103, including:

- Marmillo and Jaeger fail to teach a first fluid conduit for coupling cooler fluid from the condenser to the micro-channels (claim 6). Specifically, Jaeger "sprays" fluid onto Ics (see Jaeger, col. 3, lines 10-15). Marmillo only shows collection channels and a manifold (FIG. 3 and FIG. 4 of Marmillo); no delivery mechanism is shown. In both Marmillo and Jaeger, there is also no "return" flow of heated fluid to a condenser, due to die heating as an evaporator. In a similar manner, Marmillo and Jaeger also fail to teach a second fluid conduit for coupling warmer fluid from the micro-channels to the condenser (claim 8).

- Marmillo and Jaeger further fail to teach of suggest micro-channels that are shaped for preferential fluid flow along one direction in the micro-channels (claim 10). The Examiner states that Marmillo teaches such shapes – yet we have reviwed Marmillo and find no reference to such teachings. If the

Examiner is referring to Marmillo, FIG. 9 and FIG. 10, these figures merely teach a heat sink, and not shaped microchannels. It is impossible to render claim 10 obvious unless there is a teaching or suggestion for each claim limitation. Marmillo and Jaeger simply fail on this account, for this claim and the other claims mentioned.

- Given the arguments before, it is also unreasonable that Marmillo and Jaeger teach or suggest a condenser that is above the die such that gravity pressurizes cooler condenser fluid towards the die (claim 11).

- Marmillo and Jaeger also do not teach or suggest at least one orifice for restricting fluid flow through at least one of the micro-channels, for preferential fluid flow along one direction in the micro-channels (claim 12).

Applicants request reconsideration of claims 1-13 as to the rejection of Marmillo and Jaeger, which are insufficient to render any of these claims obvious according to 35 U.S.C. §103.

Applicants have argued and/or attended to each objection and rejection in the pending office action of May 21, 2003. Reconsideration and allowance of claims 1-13 are requested. Should any rejections persist, we ask to interview this application.

It is believed that no fees are due in connection with this amendment. If any additional fee is due, please charge Deposit Account No. 08-2025.

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